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EFFECT OF TIMING OF PARATHION AND MALATHION SPRAYS ON ORANGE PRODUCTION

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Studies of prebloom and postbloom applications of parathion against the California red scale (Aonidiella aurantii (Mask.)) on orange trees have indicated a reduction of crop by early postbloom sprays (Cressman 1). In one experiment in which mature fruits on the north half of the trees were counted, Valencia orange trees sprayed in February and March of 1954 matured nearly 100 more fruits per half-tree than adjacent rows sprayed on May 22 soon after the bloom. Size of fruit was not measured, but the difference was undoubtedly more than 0.5 field box. In a second experiment on navel orange trees sprayed in 1955, the plots sprayed on March 7 produced 1.4 more boxes per tree than those sprayed on June 14.

Additional tests on navel orange trees were started in southern California in 1956 to obtain more information on the effect of timing of parathion applications on the frequency and size of possible crop losses and the duration of the critical period after the bloom. In one grove both parathion and malathion were applied.

Procedure

Tests were made in three navel orange groves. Groves A and B were in the vicinity of Redlands and grove C at Corona. Sprays contained 1.6 pounds of 25-percent parathion or 3 pounds of 25-percent malathion per 100 gallons. All were manually applied by commercial spray crews. The first applications were made as soon as possible after the bloom and later ones at intervals of 33 to 44 days. In two groves the scarcity of red scale permitted inclusion of untreated plots. Plot size ranged from 28 to 50 trees, most plots containing 30 to 40 trees. There were four replicates of each treatment date and untreated checks. A randomized-block design was used in groves A and C, and a latin square in grove B.

Data on crop production were obtained by tallying the field boxes from each plot when picked early in 1957. There were several picking dates in each grove, and in two groves a significant number of oranges had dropped by the time of the last pick. As such fruit would have been included in earlier picks, they were boxed and added to the total for the respective plots. There was no relation between the proportion of drops and spraying date.

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[1] F. Munger and J. E. Gilmore assisted in these experiments. The following growers and sprayers cooperated: Ralph Sechrest, Don Anderson, Peter Arth, the Corona Foothill Lemon Co., and the Redlands-Highlands Pest Control Association.

Since any effects of timing of sprays might be related to the stage of development of the fruit rather than the date of application, fruit diameters were measured at the time of all except the first sprays. One hundred fruits from ten trees were selected for this purpose. Size of the fruit when picked was also estimated. Twenty oranges from the top layer of a box were measured with standard sizing rings, and sufficient boxes were sampled to equal approximately one box per tree. Fruits were divided into three size classes according to the number required to fill a packed box: smaller than 220, 220 and 200, and 176 and larger. Fruit is now marketed in cartons equal to one-half box.

The significance of the differences was determined by analysis of variance and Duncan's multiple range test (2).

Treatments for purposes other than red scale control were applied as needed. Sprays for citrus red mite (*Panonychus citri* (McG.)) were made in all groves during the fall or winter. 2,4-D was applied in the late fall for holding fruit. Grove B was sprayed with kerosene and DDT in November for black scale (*Saissetia oleae* (Bern.)). All trees in this grove were also girdled in an effort to increase production, which had been decreasing in recent years. Girdling is a fairly common practice in this area. These operations were uniform over the plots in each grove.

Results

The data on fruit production and size are summarized in table 1.

In grove A there was a significant difference between production following the May and July sprays and that following the July and later sprays. Production in plots sprayed in May was 0.7 box per tree less than the average of the plots sprayed in August and September. Plots sprayed on July 13 averaged 0.4 box less than those sprayed later.

In grove B there was no significant difference between the two treatments. Variability between plots sprayed at the same time was considerably larger than in the other groves. Therefore, it cannot be concluded that girdling overcame the tendency of the early parathion sprays to reduce the crop, although the absence of any trend is suggestive.

In grove C production in plots sprayed with parathion on June 6 was significantly less than in all other plots. The difference between the July 9 application and the later spray was not significant, but there was a small effect from this spray consistent with the results in grove A. The apparent reduction of crop by the June parathion spray was 1.0 box per tree. There was no reduction due to malathion at any time and no difference between the last parathion spray, untreated, and the average of the malathion sprays (6.4 boxes). The higher average production in the plots treated with malathion on June 6 is due to one plot of two outside rows of better trees which produced nearly eight boxes per tree.

There was no effect of spraying date or material on fruit size when picked.

Discussion

In four out of five experiments between 1954 and 1956, early postbloom applications of parathion resulted in a smaller crop than that produced in plots sprayed either earlier or later. Since there was no effect of treatment on fruit size in the 1956 experiments, the crop reduction probably was caused by dropping of young fruit. There was also evidence of a smaller reduction from sprays applied in the first half of July, but the difference was significant in only one case.

Scales on fruit are more difficult to kill with parathion than those on other parts of the tree, and the younger the fruit the less chance of infestation. Consequently the early postbloom period has been a favored time for spraying navel oranges for red scale. However, these experiments show that there is a risk of crop reduction from the early applications. They indicate that parathion can be applied after August 1, or when the average diameter of the fruit reaches 1.4 inches (the midpoint of sizes July 9 and August 22 in this experiment), without affecting production. The safety of spraying in July is questionable.

Delaying the postbloom sprays until after July increases the chances of fruit being infested. For best results with late-summer applications of parathion, red scale should be kept under good control at all times so that few scales will be present on the fruit. This timing also has advantages for suppression of black scale and citrus red mites. Comparisons with prebloom applications indicate that parathion can also be applied in February and March without reducing the following crop. If early postbloom applications are desired, malathion appears to be the safer material. It was tested in only one grove, but in this grove the early parathion sprays caused a significant loss whereas the malathion had no adverse effect.

The experimental sprays were applied under the conditions prevailing in the Corona and Redlands-Highlands areas. Presumably there would be a risk of production loss from use of early postbloom sprays in other localities, but this would need to be determined.

Summary

Early postbloom applications of parathion on May 29 and June 6 caused crop reductions of 0.7 to 1.0 field box per tree in two navel orange groves in California. There was a smaller loss from sprays in the first half of July. No reduction resulted from sprays of parathion in August or September, or malathion at any time after the bloom. The treatments had no effect on fruit size.

Literature Cited

(1) Cressman, A. W.
1956. Timing of parathion sprays on oranges. Calif. Citrogr. 41(11): 406, 408.

(2) Duncan, David B.
1955. Multiple range and multiple F. Tests. Biometrics 11(1): 1-42.

Table 1.--Orange size and production in experiments on timing of parathion and malathion sprays

Date sprayed (1956)	Average diameter of oranges when sprayed (inches)	Number of oranges per packed box		Number of field boxes per tree	
		Parathion	Malathion	Parathion	Malathion
		Grove A			
May 29	-	209	-	3.7	-
July 13	1.12	209	-	4.0	-
August 16	1.64	208	-	4.5	-
September 20	2.00	210	-	4.3	-
		Grove B			
May 29	-	213	-	5.0	-
July 13	1.15	212	-	5.6	-
August 16	1.52	212	-	4.9	-
Untreated	-	215		4.9	
		Grove C			
June 6	0.30	193	195	5.4	6.8
July 9	1.03	192	194	6.0	6.2
August 22	1.73	196	194	6.2	6.3
Untreated	-	191		6.3	

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